

The *Drosophila polychaeta* and the *D. quadrisetata* Species-Groups (Diptera: Drosophilidae) from Yunnan Province, Southern China

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ABSTRACT—Three new and four known species of the *Drosophila polychaeta* and the *D. quadrisetata* species-groups are reported from Yunnan Province, southern China. An evolutionary process of the *virilis-repleta* Radiation is discussed on the basis of the recent information from southern China.

INTRODUCTION

The present paper deals with three new and four known species of the *Drosophila polychaeta* and the *D. quadrisetata* species-groups from Yunnan Province, southern China, both of which belong to the *virilis* section of the subgenus *Drosophila*.

Most of specimens described here were collected at watersides, by using traps baited with fermenting bananas. All the holotypes and a part of paratypes are deposited in the Kunming Institute of Zoology, Academia Sinica, Kunming, China, and the remaining paratypes in the Biological Laboratory, Hokkaido University of Education, Sapporo, Japan.

DROSOPHILA POLYCHAETA SPECIES-GROUP

D. polychaeta species-group, Sturtevant, 1942, Univ. of Texas Publ., 4213: 31.

Drosophila (Drosophila) daruma Okada

Drosophila (Drosophila) daruma Okada, 1956, Syst. Study, 155.

Specimens examined. China: 1♂, 1♀, Kunming, 11. X. 1988 (Collector: H. Watabe); 3♂, 1♀, Simao, 4. XI. 1987 (X. C. Liang); 2♂, Jinhong, Xishuang-banna district, 13. IX. 1985 (W. X. Zhang); 1♂, Menghan, Xishuang-banna district, 21. IX. 1985 (W. X. Zhang).

Distribution. Korea, Japan, Malaya, Borneo, India; China: Taiwan, Guangdong, Yunnan (n. loc.).

Remarks. This species is relatively common in southern and middle parts of Yunnan Province, but has not been collected in its northern districts.

Drosophila (Drosophila) latifshahi Gupta et Ray-Chaudhuri

Drosophila (Scaptodrosophila) latifshahi Gupta et Ray-Chaudhuri, 1970 [1]: 67

Drosophila (Drosophila) latifshahi; Toda and Peng, 1989 [2]: 155.

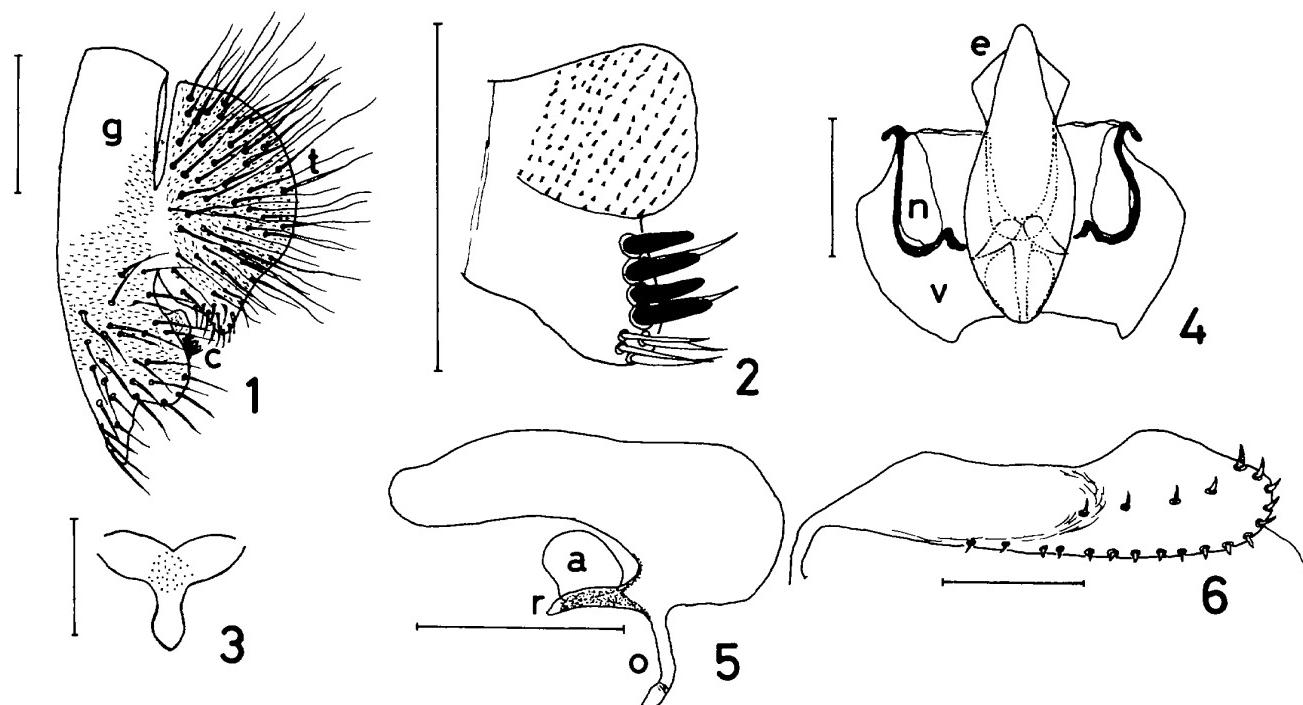
Specimens examined. China: 31♂, 14♀, Simao, 4. XI. 1987 (X. C. Liang); 1♂, Menghan, 3. X. 1985 (W. X. Zhang).

Distribution. India, Bangladesh; China: Guangdong, Yunnan (n. loc.).

Remarks. *D. latifshahi* is a dominant species of waterside drosophilids, in Simao and Xishuang-banna districts.

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Figs. 1–6. *Drosophila (Drosophila) polychaeta* Patterson et Wheeler, 1942. 1: Periphalllic organs. 2: Surstylus. 3: Decasternum. 4: Phallic organs. 5: Aedeagus (lateral view). 6: Ovipositor. Signs: a, anterior paramere; c, surstylus; e, aedeagus; n, novasternum; o, aedeagal apodeme; r, vertical rod; t, cercus; v, ventral fragma. Scale-line=0.1 mm.

Drosophila (Drosophila) polychaeta
Patterson et Wheeler
(Figs. 1–6)

Drosophila (Drosophila) polychaeta Patterson et Wheeler, 1942 [3]: 102.

Patterson and Wheeler [3] described this species based on the laboratory strain from Texas, but did not refer to its genitalia. The present specimens are supposed to belong to a native population of *D. polychaeta*, and the description of the male and female genitalia is made below, together with its diagnostic characters.

Diagnosis. Brown species with 3 pairs of post-sutural dorsocentral bristles. Palpus with ca. 2 moderate and ca. 18 short bristles. C-index ca. 1.96, C3-fringe ca. 0.93. Epandrium fused to cercus at middle; anteroventral corner sharply pointed; caudoventral corner rounded (Fig. 1). Spermatheca unsclerotized.

Periphalllic organs (Figs. 1–3): Epandrium brown, darker on lower margin, pubescent except in upper portion and ventral margin, with ca. 30 bristles on lower half. Surstylus distally constricted into two parts; upper part flap-shaped, with tiny

thorn-like spines in somewhat regular rows; lower part nearly quadrate, with ca. 4 primary teeth and ca. 2 bristles on distal margin, and with ca. 5 bristles at caudoventral corner. Cercus oval, ventrally narrowing, entirely pubescent with ca. 53 long bristles and tuft of ca. 11 short bristles at lower apex. Decasternum pale brown, Y-shaped in ventral view, medially with small dark patches.

Phallic organs (Figs. 4, 5): Aedeagus T-shaped in lateral view, proximally broadened; aedeagal apodeme short, ca. 1/4 as long as aedeagus. Anterior paramere oval, without sensilla; posterior paramere absent. Vertical rod dark brown. Novasternum nearly triangular, without submedian spines. Ventral fragma laterally flattened, distally concaved in middle.

♀ reproductive organs (Fig. 6): Lobe of ovipositor pale orange, dorso-submedially expanded, with ca. 4 discal teeth, ca. 24 spine-like marginal teeth and 1 subterminal hair; ultimate marginal tooth darker than penultimate. Spermatheca very small, embedded in adipose tissue.

Specimens examined. China: 12♂, 13♀, Simao, 4. XI. 1987 (X. C. Liang).

Distribution. Neotropics, Micronesia, Hawaii,

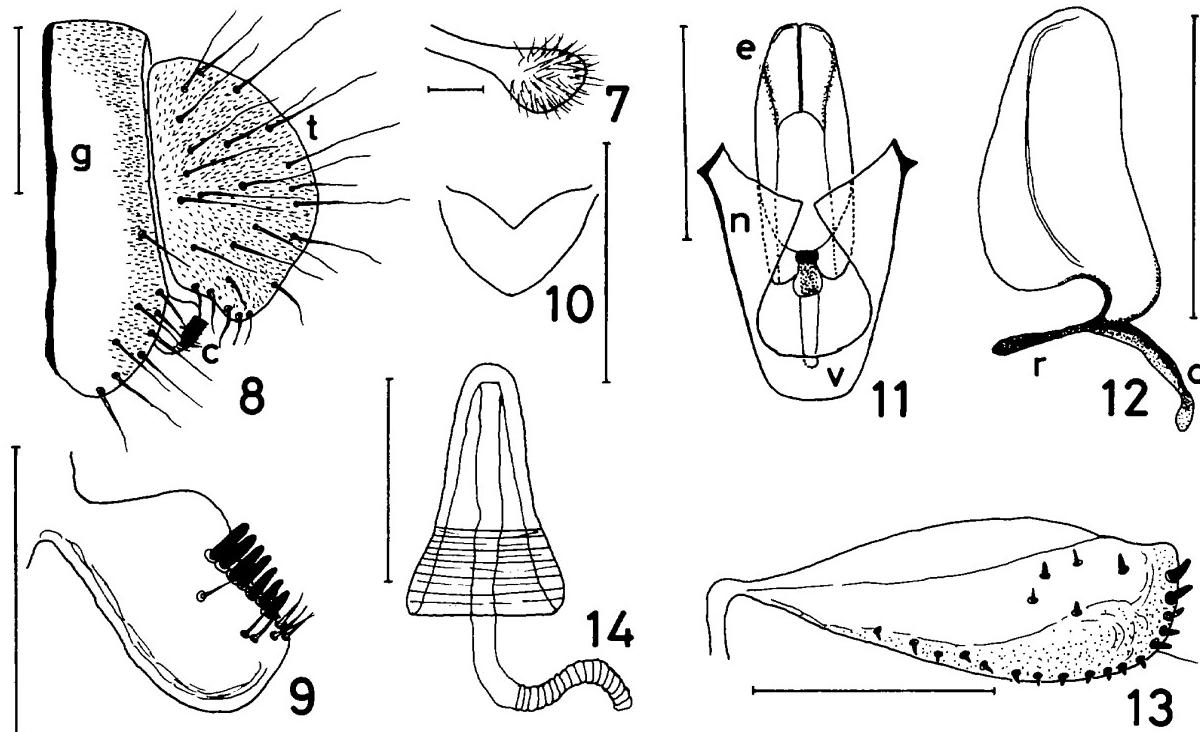
North America, Europe; China (n. loc.): Yunnan.

Origin. *D. polychaeta* is cosmopolitan, but its extremely wide range of distribution is probably due to the propagation with man [4]. Fonseca [5] states that *D. polychaeta* is frequently collected on ships in British ports but does not establish its permanent population there. The origin of this species was unknown. The present collection was made in a natural subtropical forest remote from a human residence. This suggests that southern China might be the original distribution range of *D. polychaeta*.

***DROSOPHILA QUADRISETATA* SPECIES-GROUP**

D. quadrisetata species-group: Toda and Peng, 1989 [2]: 158.

This group is very small, and consisted of only three species: *D. potamophila* Toda et Peng and *D. beppui* Toda et Peng from southern China, and *D. quadrisetata* Takada, Beppu et Toda from northern Japan. The last species was previously included in the *polychaeta* species-group [6]. Three new species are added in this article.



Figs. 7-14. *Drosophila (Drosophila) karakasa* Watabe et Liang, sp. nov. 7: Palpus. 8: Periphalllic organs. 9: Surstylius. 10: Decasternum. 11: Phallic organs. 12: Aedeagus (lateral view). 13: Ovipositor. 14: Spermatheca. Signs and scales as in figs. 1-6.

***Drosophila (Drosophila) potamophila* Toda et Peng**

Drosophila (Drosophila) potamophila Toda et Peng, 1989 [2]: 159.

Specimens examined. China: 1♂, 1♀, Simao, Yunnan Province, 4. XI. 1987 (X. C. Liang).

Distribution. China: Guangdong, Yunnan (n. loc.).

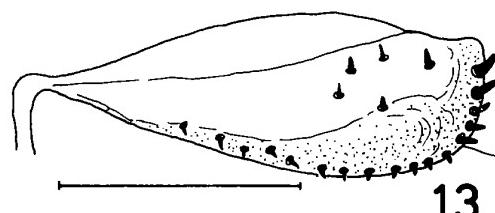
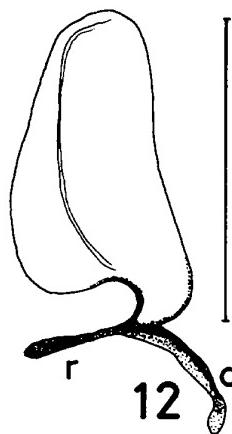
Remarks. This species is abundant in subtropical districts of Yunnan, but has not been collected in Kunming (center of Yunnan) and Dali (northern Yunnan) districts.

Drosophila (Drosophila) karakasa

Watabe et Liang, sp. nov.

(Figs. 7-14)

Diagnosis. Small and yellowish brown species with cercus separated from epandrium. Palpus short, with short hairs but without stout bristles (Fig. 7). 4C-index ca. 7/9 and C3-fringe ca. 3/5. Surstylus rectangular, distally with ca. 7 primary teeth and ca. 7 short bristles (Fig. 9). Lobe of ovipositor brown, much darker on ventral margin, roundish at tip (Fig. 13). Spermatheca cone-



shaped, with sparse horizontal stripes on basal half of outer capsule (Fig. 14).

♂, ♀. Body length, ♂ ca. 2.33 mm (range: 2.1–2.5), ♀ ca. 2.31 mm (2.1–2.5). Wing length, ♂ ca. 2.83 mm (2.6–3.0), ♀ ca. 2.73 mm (2.6–2.8).

Head: Eye red with thick piles. Second joint of antenna reddish brown; 3rd grayish brown. Arista with ca. 4 (4–6) upper and ca. 2 (2–3) lower short branches in addition to terminal fork. Frons dark brown, ca. 0.54 (0.43–0.65) as broad as head, anteriorly with a few frontal hairs. Anterior reclinate orbital (Orb 2) ca. 0.44 (0.33–0.56) length of posterior reclinate orbital (Orb 1); proclinate orbital (Orb 3) ca. 0.63 (0.56–0.78) length of Orb 1. Face brown; carina somewhat low, narrow. Clypeus reddish brown. Cheek tannish brown, ca. 0.25 (0.20–0.31) as broad as maximum diameter of eye, with ca. 3 long bristles along lower margin. Second oral (Or 2) minute, ca. 0.29 (0.23–0.36) length of vibrissa (Or 1). Palpus brown, club-shaped, basally baring (Fig. 7).

Thorax: Mesoscutum yellowish brown, medially with a darker longitudinal stripe running to scutellum. Scutellum brown, paler on lateral sides. Lower humeral ca. 0.70 (0.55–0.86) length of upper one. Two extra pairs of dorsocentrals present in front of usual ones. Anterior acrostichal bristles present between 1st (anteriormost) dorsocentrals; posterior ones between 2nds; length and location of acrostichal bristles more or less variable. Relative lengths of dorsocentrals and acrostichal bristles to 4th (posteriormost) dorsocentral: 1st dorsocentral ca. 0.57 (0.51–0.62), 2nd ca. 0.57 (0.49–0.62), 3rd ca. 0.71 (0.65–0.79), anterior acrostichal bristle ca. 0.35 (0.29–0.43), posterior one ca. 0.53 (0.46–0.68). Length distance from 1st dorsocentral to 2nd ca. 0.57 (0.52–0.68), distance from 2nd to 3rd ca. 0.48 (0.44–0.55), distance from 3rd to 4th ca. 0.56 (0.52–0.64) cross distance between 3rds. Acrostichal hairs (Ac) sparse, in 4 irregular rows. Anterior scutellars (SctA) nearly parallel and posterior ones (Sctp) convergent; SctA ca. 1.07 (0.88–1.17) length of SctP. Sterno-index ca. 0.72 (0.64–0.76).

Legs light brown; preapicals on all three tibiae; apicals on fore and mid tibiae.

Wing hyaline, slightly fuscous. Veins dark brown; crossveins clear. R₂₊₃ straight; R₄₊₅ and

M parallel. C₁ bristles 2, subequal. Number of small stout bristles on 3rd costa (3CFr) ca. 28 (24–33). Wing indices: C in ♂ ca. 3.10 (2.96–3.34) and in ♀ ca. 2.77 (2.50–3.11), 4V ca. 1.64 (1.54–1.87), 4C ca. 0.77 (0.70–0.86), 5X ca. 1.57 (1.33–1.73), Ac in ♂ ca. 2.26 (2.17–2.36) and in ♀ ca. 2.64 (2.14–3.00), C3-fringe ca. 0.61 (0.52–0.67). Haltere white, basally brown.

Abdomens: Tergites brown, darker on middle and paler on lateral margin. Sternites brown, darker on posterior margin, nearly quadrate.

Periphallic organs (Figs. 8–10): Epandrium yellowish brown, darker on anterior margin, pubescent on posterior half, with ca. 9 bristles on lower half. Surstylus pale brown, marginally darker, somewhat swollen at caudodorsal corner. Decasternum translucent, heart-shaped. Cercus brown, slightly projecting at ventral apex, entirely pubescent, with ca. 17 long bristles and tuft of ca. 5 short bristles along lower margin.

Phallic organs (Figs. 11, 12): Aedeagus yellow, bilobed, ventrally broadened; apodeme dark brown, ca. 3/8 as long as aedeagus. Anterior paramere small. Vertical rod black, plate-shaped in ventral view. Novasternum pale brown, without submedian spines; ventral fragma narrow.

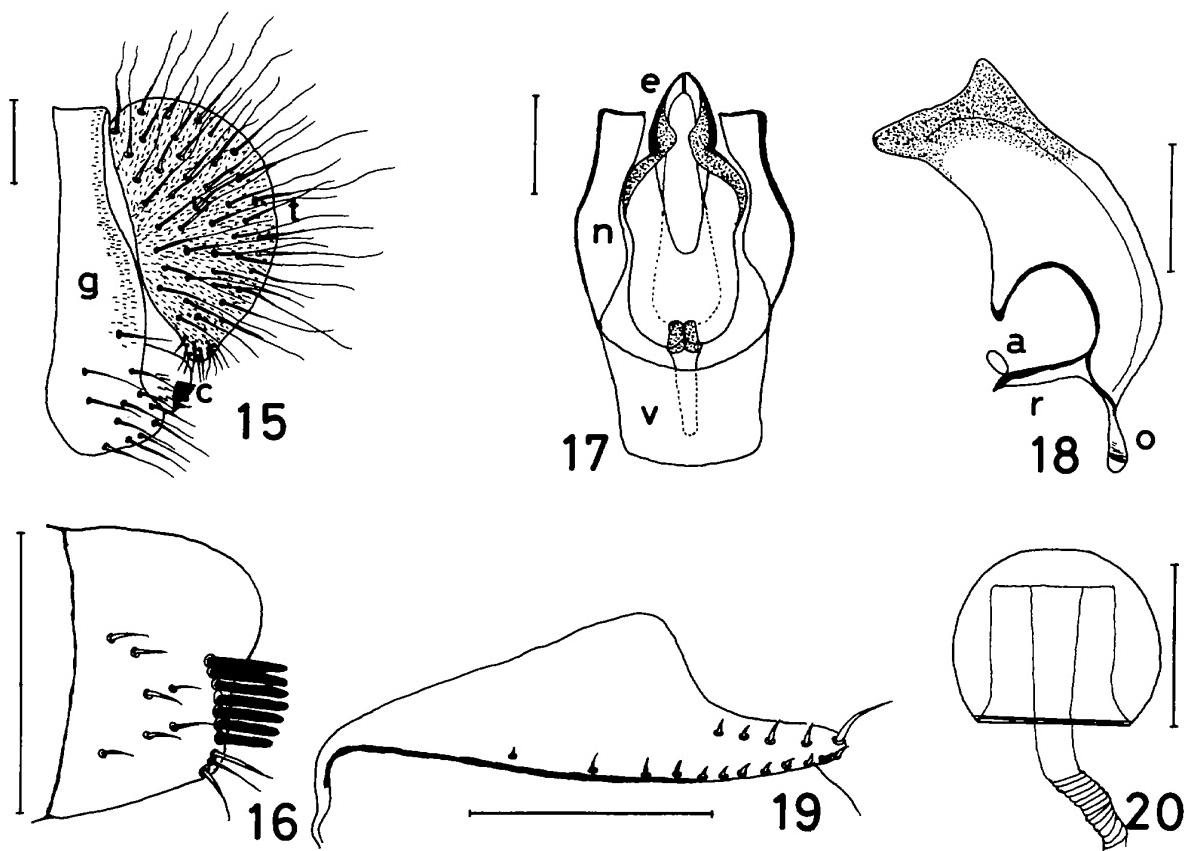
♀ reproductive organs (Figs. 13, 14): Lobe of ovipositor with ca. 3–5 discal teeth and ca. 17 short marginal teeth: first 2 marginal teeth darker and larger than others. Spermatheca grayish brown, slightly constricted in middle; introvert deep.

Holotype ♂, China: Xianguan, Dali district, Yunnan Province, 19. IX. 1988 (X. C. Liang).

Paratypes, China: 1 ♂, same data as holotype, 2 ♀, Dabochin, Dali district, Yunnan Province, 21. IX. 1988 (X. C. Liang).

Distribution. China: Yunnan; Dabochin, Xianguan.

Relationships. *D. karakasa* somewhat resembles the foregoing species, *D. potamophila*, in the general morphology and chaetotaxy, but clearly distinguishable from the latter by the diagnostic characters. The aedeagus of this species is very similar to that of four species of the *D. robusta* species-group: *D. okadai* Takada, *D. neokadai* Kaneko et Takada, *D. gani* Liang et Zhang and *D. unimaculata* Strobl [7].



Figs. 15–20. *Drosophila (Drosophila) barutani* Watabe et Liang, sp. nov. 15: Periphalllic organs. 16: Surstyli. 17: Phallic organs. 18: Aedeagus (lateral view). 19: Ovipositor. 20: Spermatheca. Signs and scales as in figs. 1–6.

Drosophila (Drosophila) barutani
Watabe et Liang, sp. nov.
(Figs. 15–20)

Diagnosis. Dull brown species with cercus close to epandrium at middle (Fig. 15). Third oral subequal to vibrissa. Palpus with ca. 3 moderate bristles. 4C-index ca. 5/9 and C3-fringe ca. 9/10. Surstylus arc-shaped, broadened at caudodorsal corner (Fig. 16). Lobe of ovipositor sharply pointed at tip; ultimate marginal tooth large, bristle-like (Fig. 19). Spermatheca hemispherical (Fig. 20).

♂, ♀. Body length, ca. 3.60 mm (3.4–3.8). Wing length, ca. 4.03 mm (3.9–4.1).

Head: Eye brownish red with thick piles. Second joint of antenna reddish brown; 3rd blackish brown. Arista ca. 4 (4–6) upper and ca. 2 (1–2) lower short branches in addition to terminal fork. Frons reddish brown, ca. 0.47 (0.46–0.48) as broad as head, anteriorly with a few frontal hairs. Orb 2 ca. 0.32 (0.31–0.34) length of Orb 1; Orb 3 ca. 0.40 (0.33–0.47) length of Orb 1. Face brown; carina

broad. Clypeus dark red. Cheek reddish brown, ca. 0.28 (0.24–0.33) as broad as maximum diameter of eye, with ca. 3 long bristles along lower margin. Or 2 thin, ca. 0.16 (0.14–0.17) length of Or 1; Or 3 ca. 0.99 (0.92–1.11) length of Or 1. Palpus grayish brown, laterally flattened.

Thorax: Mesoscutum brown, with 4 darker longitudinal stripes. Scutellum brown, lateral sides black. Lower humeral ca. 0.58 (0.55–0.59) length of upper one. Two extra pairs of dorsocentrals present. Anterior acrostichal bristles present between 1st dorsocentrals; posterior slightly below cross line between 2nds. Relative lengths of dorsocentrals and acrostichal bristles to 4th dorsocentral: 1st (anteriormost) dorsocentral ca. 0.66 (0.65–0.67), 2nd ca. 0.68 (0.62–0.74), 3rd ca. 0.86 (0.79–0.98), anterior acrostichal bristle ca. 0.58 (0.48–0.70), posterior one ca. 0.54 (0.52–0.57). Length distance from 1st dorsocentral to 2nd ca. 0.64 (0.60–0.71), distance from 2nd to 3rd ca. 0.55 (0.50–0.61), distance from 3rd to 4th ca. 0.58 (0.55–0.61) cross distance between 3rds. Ac

sparse, in 6 irregular rows. SctAs parallel and Sctps convergent; SctA ca. 0.97 (0.93–1.03) length of SctP. Sterno-index ca. 0.72 (0.52–0.84).

Legs dark brown; coxae and trochanters paler. Fore femur posteriorly with ca. 5 bristles. Preapicals on all three tibiae; apicals on fore and mid tibiae.

Wing hyaline, slightly fuscous. Veins dark brown; crossveins clear. R_{2+3} nearly straight; R_{4+5} and M parallel. C_1 bristles 2, inner bristle ca. 5/9 length of outer one. Number of 3CFr ca. 38 (35–40). Wing indices: C ca. 3.46 (3.04–3.70), 4V ca. 1.61 (1.56–1.70), 4C ca. 0.57 (0.53–0.62), 5X ca. 1.06 (1.00–1.17), Ac ca. 2.01 (1.82–2.20), C3-fringe ca. 0.90 (0.87–0.94). Haltere pale yellow; stalk anteriorly darker.

Abdomens: Tergites entirely dark brown. Sternites pale grayish brown, nearly quadrate; ♂ 5th slightly convexed posteriorly.

Periphallic organs (Figs. 15, 16): Epandrium brown, dorsally narrowing and ventrally broadened, posteriorly pubescent except lower portion, with ca. 12 bristles. Surstylus dark brown, distally with ca. 7 primary teeth on margin and ca. 3 bristles at caudoventral corner, medially with ca. 7 spine-like bristles on outer surface. Cercus dark brown, somewhat projecting ventrally, entirely pubescent, with ca. 38 long bristles and tuft of ca. 12 short bristles at lower apex.

Phallic organs (Figs. 17, 18): Aedeagus yellowish brown, much darker at distal portion, bilobed, concaved on distal margin; apodeme short, ca. 2/7 as long as aedeagus. Anterior paramere rudiment. Vertical rod brown, ventrally black. Novasternum narrow; ventral fragma handmill-shaped.

♀ reproductive organs (Figs. 19, 20): Lobe of ovipositor brown, marginally black, dorso-subapically swollen, with ca. 4 discal teeth and ca. 13 marginal teeth in regular row; ultimate marginal tooth prominent, ca. 3 times as long as penultimate. Spermatheca pale yellow, apically somewhat flattened, wrinkled on basal margin, without apical indentation; introvert deep, ca. 5/8 height of outer capsule.

Holotype ♂, China: Dabochin, Dali district, Yunnan Province, 21. IX. 1988 (X. C. Liang).

Paratypes, China: 1 ♂, Xianguan, Dali district, Yunnan Province, 21. IX. 1988, (X. C. Liang);

1 ♀, same data as holotype.

Distribution. China: Yunnan; Dabochin, Xianguan.

Relationships. *D. barutani* is somewhat similar to *D. potamophila* in the abdominal coloration and large value of C3-fringe, but easily distinguishable from the latter by the shapes of its aedeagus and ovipositor.

Drosophila (Drosophila) multidentata

Watabe et Zhang, sp. nov.

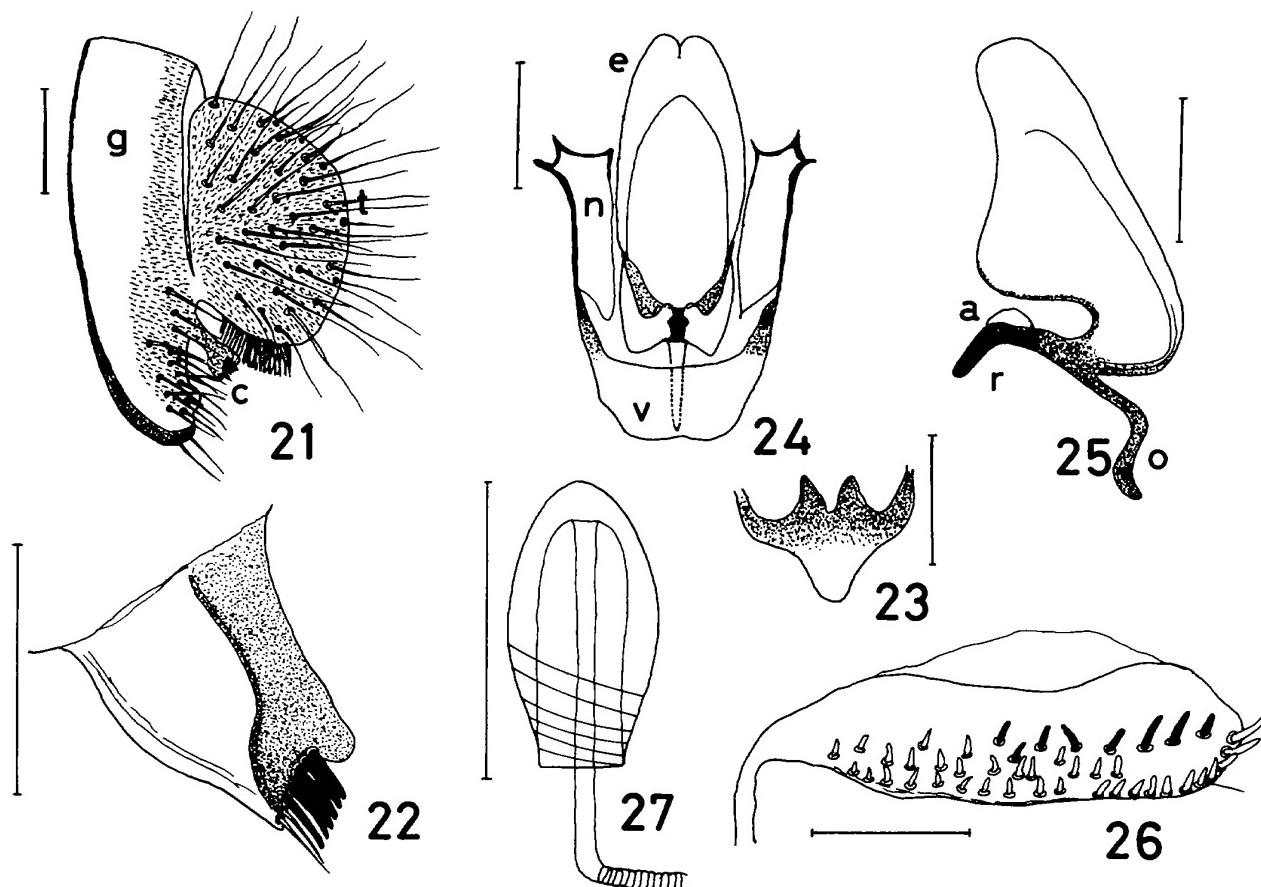
(Figs. 21–27)

Diagnosis. Dull brown species, with cercus fused to epandrium at submedian portion (Fig. 21). Or 2 ca. 4/9 length of Or 1. C3-fringe ca. 5/9. Lobe of ovipositor with many irregular teeth (Fig. 26). Spermatheca slender, with sparse oblique lines on basal 1/3 of outer capsule (Fig. 27).

♂, ♀. Body length, ♂ ca. 2.55 mm (2.4–2.8), ♀ ca. 2.85 mm (2.6–3.1). Wing length, ♂ ca. 3.18 mm (3.0–3.5), ♀ ca. 3.48 mm (3.2–3.8).

Head: Eye dark red with thick piles. Second joint of antenna dark brown; 3rd grayish brown. Arista with ca. 4 (3–4) upper and ca. 1 lower branches in addition to short terminal fork. Frons dark brown, ca. 0.46 (0.42–0.49) as broad as head, medially with black cuneiform line. Orb 2 ca. 0.36 (0.25–0.46) length of Orb 1; Orb 3 ca. 0.52 (0.42–0.79) length of Orb 1. Face reddish brown; carina very high, wider below. Clypeus blackish brown. Cheek brown, ca. 0.26 (0.23–0.31) as broad as maximum diameter of eye, with ca. 3 long and ca. 11 short bristles along lower margin. Or 2 thin, ca. 0.44 (0.23–0.61) length of Or 1; Or 3 minute. Palpus brown, small, club-shaped, with 1 somewhat long bristle at tip.

Thorax: Mesoscutum brown, medially darker; scutellum dark brown. Lower humeral ca. 0.61 (0.44–0.69) length of upper one. Anterior acrostichal bristles present below cross line between 1st dorsocentrals; posterior below cross line between 2nds. Relative lengths of dorsocentrals and acrostichal bristles to 4th dorsocentral: 1st dorsocentral (anteriormost) ca. 0.46 (0.39–0.52), 2nd ca. 0.51 (0.39–0.58), 3rd ca. 0.68 (0.60–0.79), anterior acrostichal bristle ca. 0.33 (0.24–0.44), posterior one ca. 0.42 (0.37–0.44). Length distance from 1st



Figs. 21–27. *Drosophila* (*Drosophila*) *multidentata* Watabe et Zhang, sp. nov. 21: Periphalllic organs. 22: Surstyli. 23: Decasternum. 24: Phallic organs. 25: Aedeagus (lateral view). 26: Ovipositor. 27: Spermatheca. Signs and scales as in figs. 1–6.

dorsocentral to 2nd ca. 0.55 (0.44–0.74), distance from 2nd to 3rd ca. 0.45 (0.39–0.48), distance from 3rd to 4th ca. 0.51 (0.46–0.56) cross distance between 3rds. Ac in 6 irregular rows; a few acrostichal hairs in rows of dorsocentrals somewhat longer than other hairs. SctAs slightly and SctPs heavily convergent; SctA ca. 0.96 (0.86–1.05) length of SctP. Sterno-index ca. 0.73 (0.52–0.96).

Legs brown; fore tarsi darker. Fore femur posteriorly with ca. 2–3 long bristles. Preapicals on all three tibiae; apicals on fore and mid tibiae.

Wing hyaline, slightly fuscous. Veins dark brown; crossveins clear. R_{2+3} nearly straight; R_{4+5} and M parallel. C_1 bristles 2, subequal. Number of 3CFr ca. 24 (17–28). Wing indices: C ca. 3.54 (3.12–4.20), 4V ca. 1.69 (1.52–1.78), 4C ca. 0.68 (0.60–0.77), 5X ca. 1.22 (1.00–1.50), Ac ca. 2.00 (1.67–2.13), C3-fringe ca. 0.56 (0.43–0.65). Haltere white; stalk grayish brown.

Abdomens: Tergites grayish brown, darker in middle; sternites brown, each with ca. 26–34 bristles.

Periphalllic organs (Figs. 21–23): Epandrium brown, darker on anterior margin, posteriorly pubescent, with ca. 15 bristles on lower half and ca. 2 bristles along ventral margin. Surstyli brown, darker on upper half, distally narrowing, slightly projecting at caudodorsal corner, with ca. 6 primary teeth and ca. 2 bristles. Decasternum dark brown, paler on lower portion. Cercus blackish brown, with ca. 34 long bristles and tuft of ca. 23 pale yellow bristles along ventral margin.

Phallic organs (Figs. 24, 25): Aedeagus yellow, bilobed, submedially broadened; apodeme dark brown, ca. 1/3 as long as aedeagus. Anterior paramere pale yellow, hemispherical. Vertical rod black, recurved dorsally. Novasternum pale yellow, darker on lateral margin, without submedian spines; ventral fragma slightly concaved at middle.

♀ reproductive organs (Figs. 26, 27): Lobe of ovipositor dark brown, with ca. 45 stout teeth in irregular rows and 1 long subterminal hair; ca. 8 upper teeth much darker than others. Spermatheca grayish brown, slightly wrinkled basally; introvert deep; inner duct narrow.

Holotype ♂, China: Xianguan, Dali district, Yunnan Province, 19. IX. 1988 (X. C. Liang).

Paratypes, China: 2♂, 2♀, Dabochin, Dali district, Yunnan Province, 21. IX. 1988 (H. Watabe & X. C. Liang).

Distribution. Yunnan; Dabochin, Xianguan, Kunming.

Relationships. One of the diagnostic characters for the *D. quadrisetata* species-group described by Tada and Peng [2] is "cercus separated from epandrium". The cercus of *D. multidentata* fuses to epandrium at its lower portion. However, *D. multidentata* should be involved in the *quadrisetata* species-group by the following characters: 1) two extra pairs of dorsocentrals and prominent acrostichal bristles present, 2) C-index ca. 3.54, 3) 4V-index ca. 1.69, and 4) aedeagus large and curved ventrally.

Since the cercus in the *robusta* species-group fuses to epandrium, the same type cercus found in *D. multidentata*, as well as the large value of C-index and the shape of aedeagus, implies the phylogenetic relationship between this species and the *robusta* group [2, 7].

THE VIRILIS-REPLETA RADIATION IN THE OLD WORLD

The *virilis-repleta* Radiation, which might have occurred during the Oligocene to early Miocene, is one of main lineages in the evolution of the genus *Drosophila*. Throckmorton [4] considers that first the *polychaeta* group might have emerged in the Old World tropics and then several groups, e.g., the *robusta*, the *virilis* and the *melanica* species-groups, might have diverged adaptively in its temperate forest. However, the phylogenetic relationship among these species-groups, especially between the *polychaeta* group and other groups, was still open to question, mainly due to the insufficient information from China.

The recent *Drosophila*-survey in southern China

has resulted in the establishment of a new species-group, the *quadrisetata* group. This group is closely related to the *polychaeta* group in the external morphology and to the *robusta* group in the male genitalia. Toda and Peng [2] consider that the *quadrisetata* group occupies a systematic position between these two species-groups. Similarly, a geographical information on the distribution of these three groups has made it possible to trace the evolutionary process. Most of the *polychaeta* group flies are distributed from the tropics to the subtropics of the East Asia, whereas the *robusta* group flies in its temperate zone [1, 2, 4, 8]. The distribution range of the *quadrisetata* group overlaps with that of the *polychaeta* group and that of the *robusta* group. Of six *quadrisetata* group species, *D. potamophila* and *D. beppui* are distributed in the subtropics and the remaining four species in the temperate forest [2, 6, 8]. In particular, in northern Yunnan, the present three new species are sympatric to *D. neokadai* and *D. gani* of the *robusta* species-group [9].

These information from southern China, including the discovery of *D. polychaeta* in a natural forest of Simao, strongly supports the Throckmorton's hypothesis: the *polychaeta* group first emerged in the Old World tropics and then the *robusta* group in the temperate forest of the East Asia probably through the emergence of the *quadrisetata* group in its subtropics.

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REFERENCES

- 1 Gupta, J. P. and Ray-Chaudhuri, S. P. (1970) Some new and unrecorded species of *Drosophila* (Diptera: Drosophilidae) from India. Proc. Roy. ent. Soc. Lond., (B) **39**: 57-72.
- 2 Toda, M. J. and Peng, T. X. (1989) Eight species of the subgenus *Drosophila* (Diptera: Drosophilidae) from Guangdong Province, southern China. Zool. Sci., **6**: 155-166.

- 3 Patterson, J. T. and Wheeler, M. R. (1942) Description of new species of the subgenus *Hirtodrosophila* and *Drosophila*. Univ. of Texas. Publ., **4213**: 67–109.
- 4 Throckmorton, L. H. (1975) The phylogeny, ecology, and geography of *Drosophila*. In "Handbook of Genetics, Vol. III". Ed. by R. C. King, Plenum Publ., New York, pp. 421–469.
- 5 Fonseca, E. C. M. d'A (1965) A short key to the British Drosophilidae (Diptera) including a new species of *Amiota*. Trans. Soc. Brit. Ent., **16**: 233–244.
- 6 Takada, H., Beppu, K. and Toda, M. J. (1979) *Drosophila* Survey of Hokkaido, XXXVI. New and unrecorded species of Drosophilidae. J. Fac. Gener. Edu., Sapporo Univ., **14**: 105–129.
- 7 Watabe, H. and Nakata, S. (1989) A comparative study of genitalia of the *Drosophila robusta* and *D. melanica* species-groups (Diptera: Drosophilidae). J. Hokkaido Univ. of Education, Ser. IIB, **40**: 1–18.
- 8 Beppu, K., Peng, T. X. and Xie, L. (1989) An ecological study on drosophilid flies (Diptera, Drosophilidae) living at watersides in southern China. Jpn. J. Ent. (Kontyû, Tokyo), **57**: 185–198.
- 9 Watabe, H., Liang, X. C. and Zhang, W. X. (1990) The *Drosophila robusta* species-group (Diptera: Drosophilidae) from Yunnan Province, southern China, with the revision of its geographic distribution. Zool. Sci., **7**: 133–140.